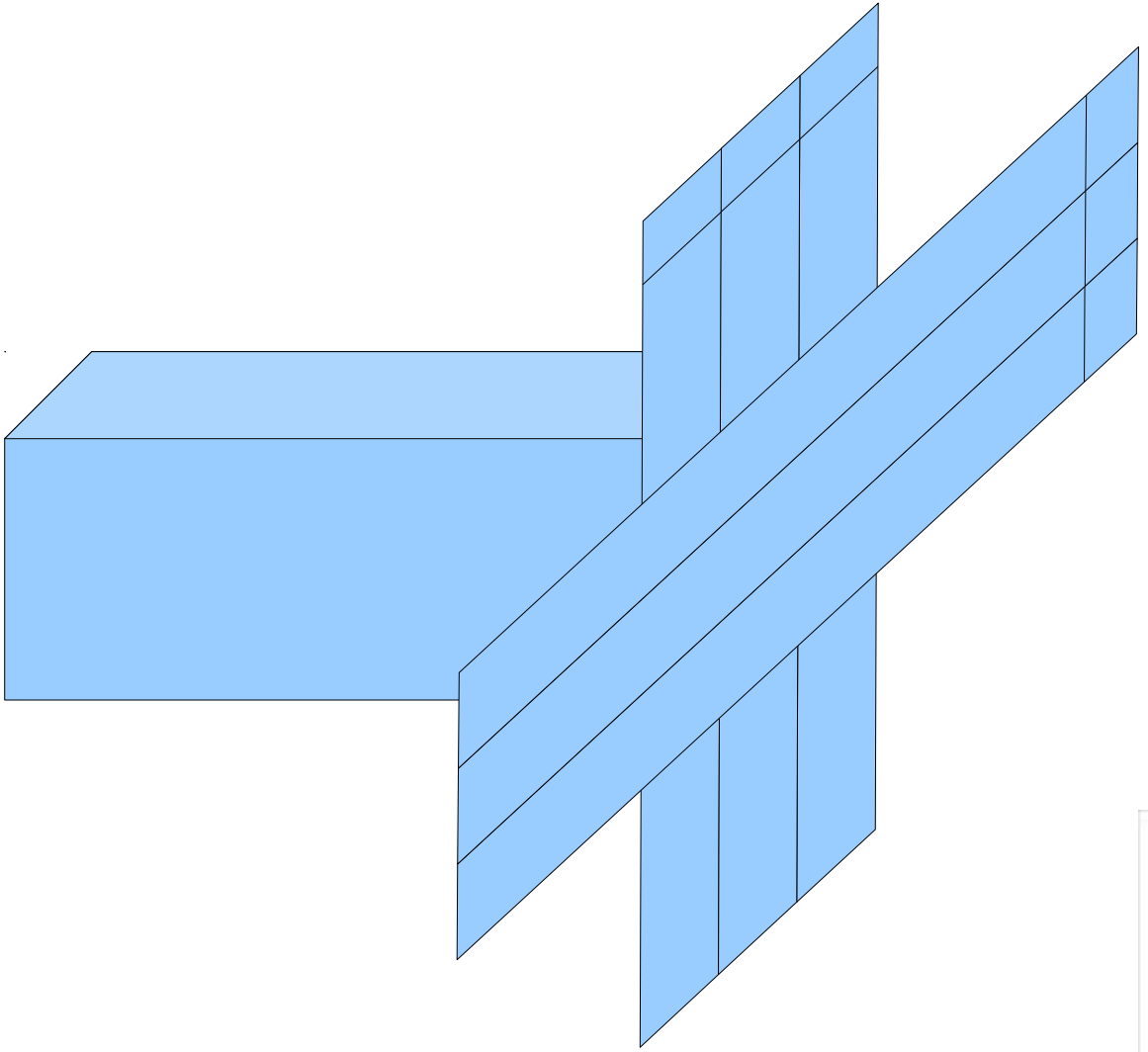
Design Concepts for the LArIAT Punch-Through Veto



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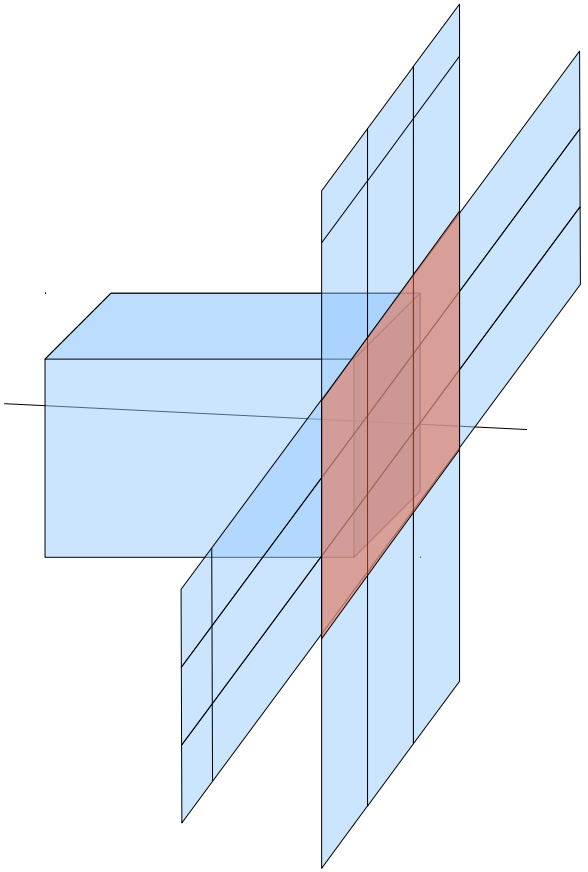
Outline

- Purpose of Veto
- Scintillator Types
  - CDF Long Paddles with efficiency tests
  - Fishtail
- Paddle Arrangements
- Future Work and Conclusions

Purpose for the Punch-Through Veto

- Detect particles passing completely through the TPC which do not deposit all of their energy inside.

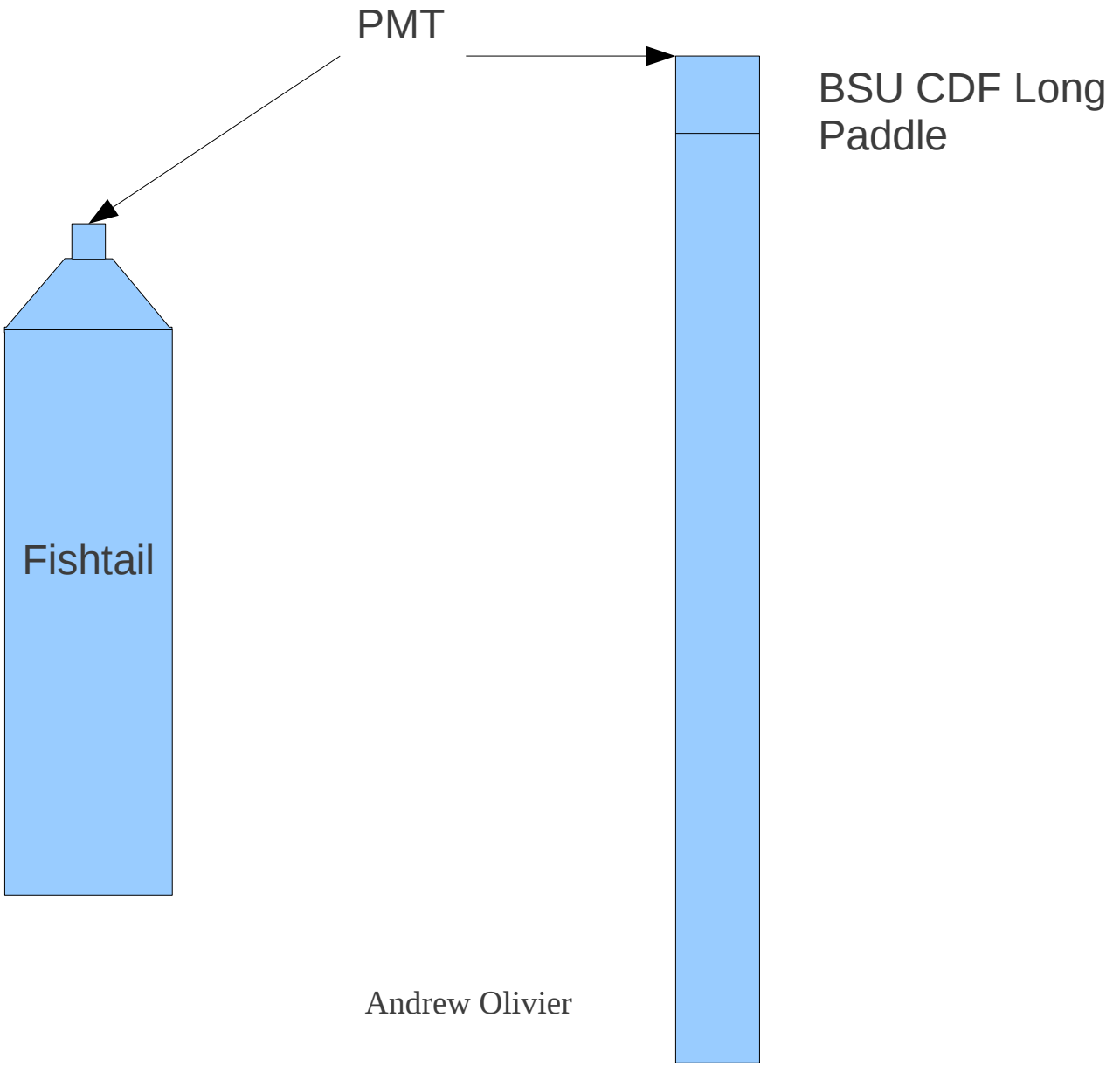


*Cryostat not shown

Problems Faced in Veto Design

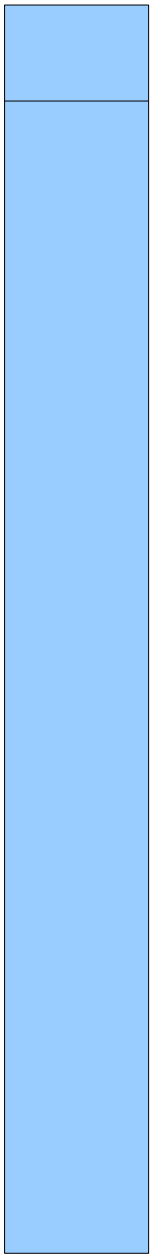
- Cosmic rays will also be detected by the scintillators potentially excluding usable events
- Particles exiting the TPC may scatter at wide angles and go undetected by a veto with a small active area

Available Paddles

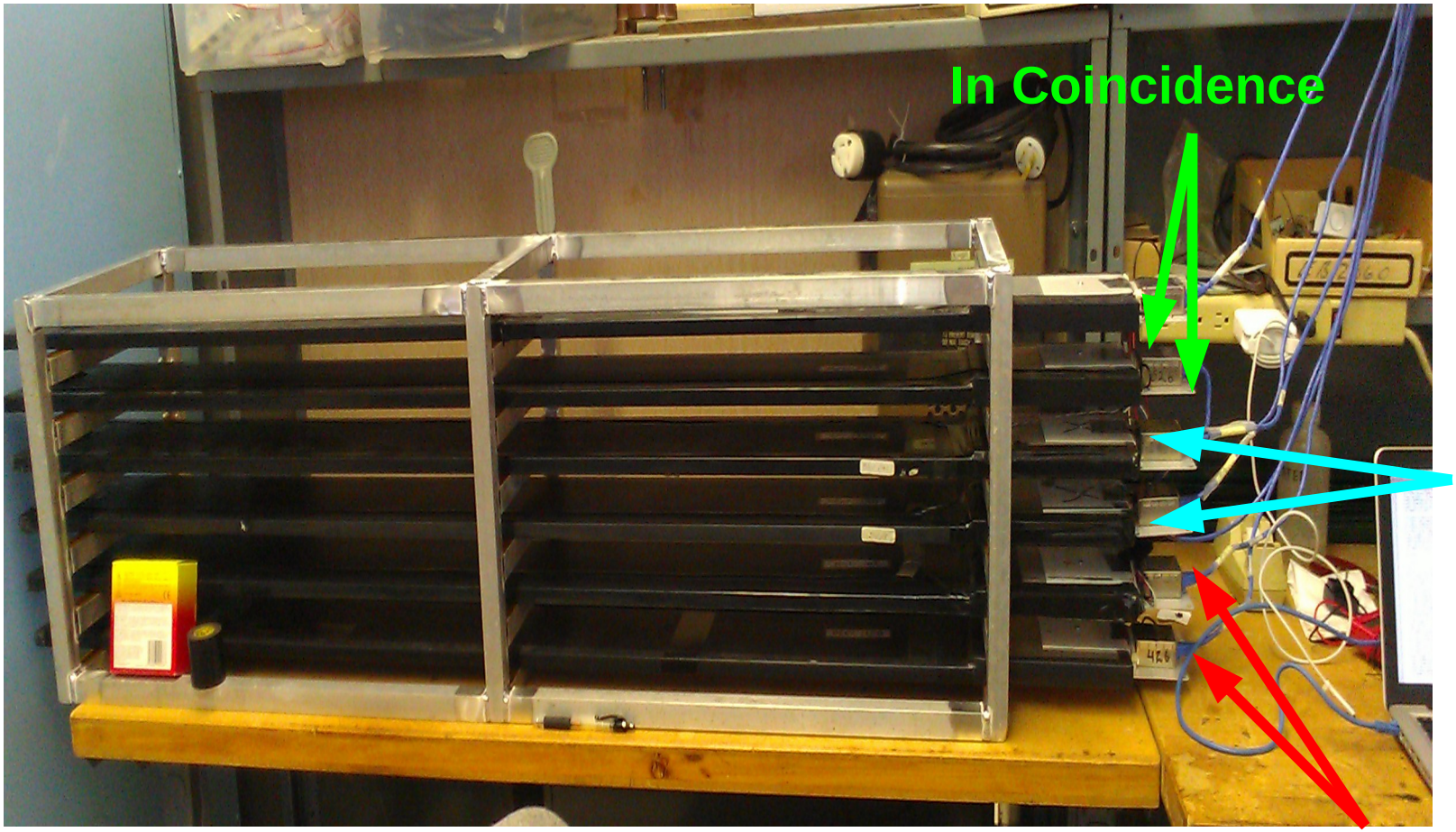


CDF Long Paddles

- Dimensions: 16.7 x 148.3 cm^2
- Noisy PMTs
  - Tests have been performed which conclude that these scintillators have significantly more noise than is expected for fishtail paddles (~ 60%)
  - Run on about 13 V which is much lower than the supply voltage needed for Fishtails

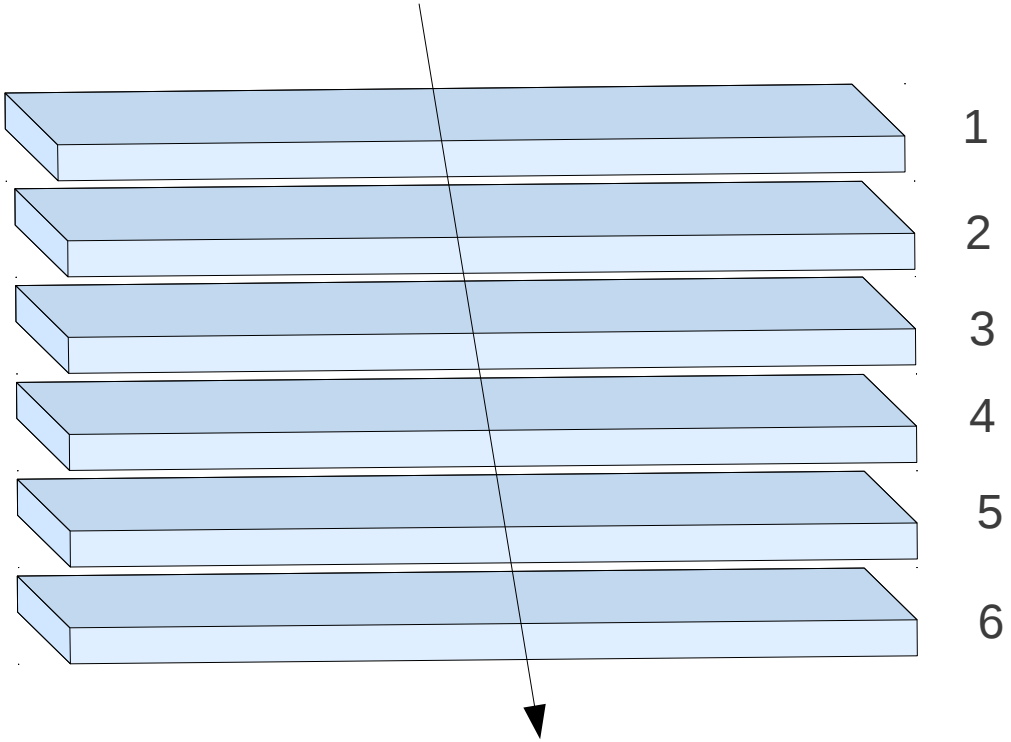


Efficiency and Noise Measurements



Efficiency and Noise Definitions

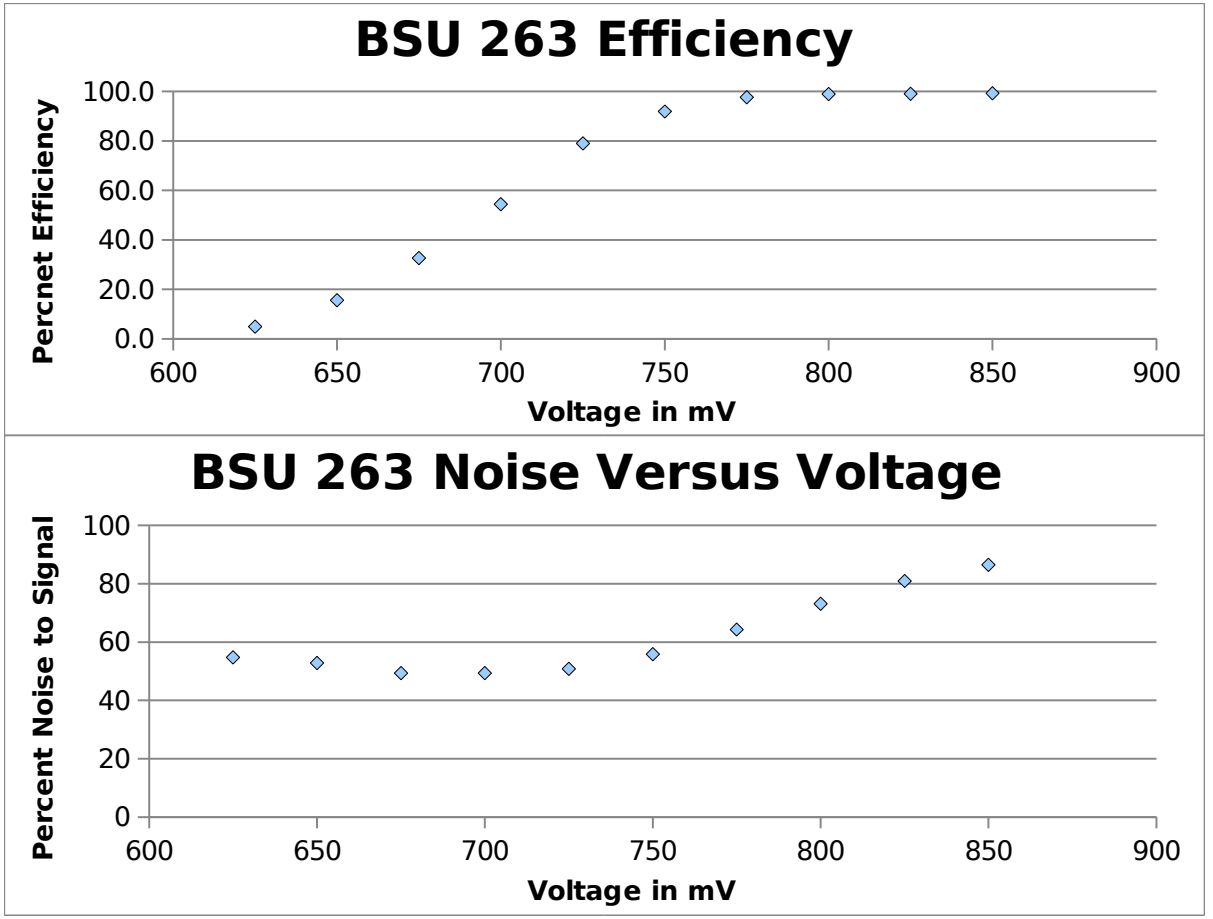
- % Efficiency = (5-fold coincidence) / (4-fold coincidence) * 100
- % Noise = (Single – (3-fold)) / single * 100



3-fold = ((1 and 2) or (5 and 6)) and test

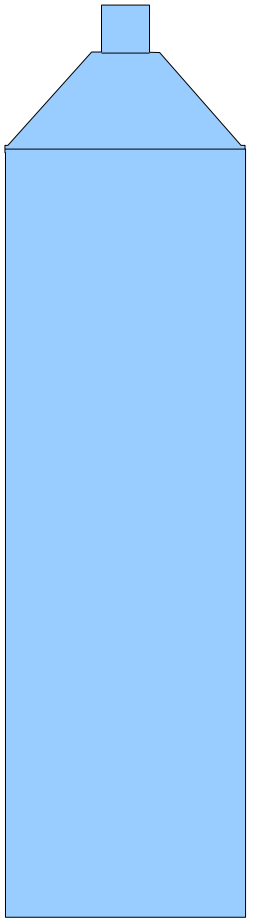
Data on CDF Long Paddles

- Examples of scintillator paddle measurements



Fishtail Paddles

- Dimensions: 30.96 x 99.54 cm^2
- Expected to be less noisy
  - Tests have not yet been performed
  - Run on higher voltage (~ -1000V)

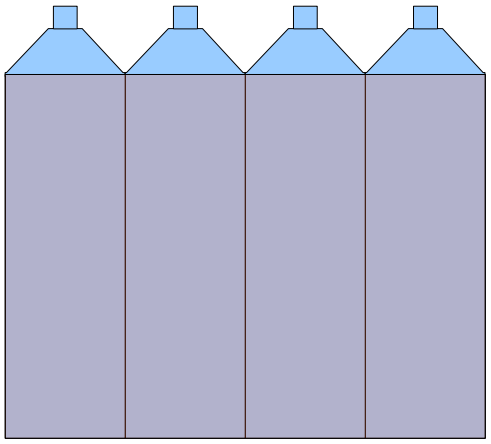


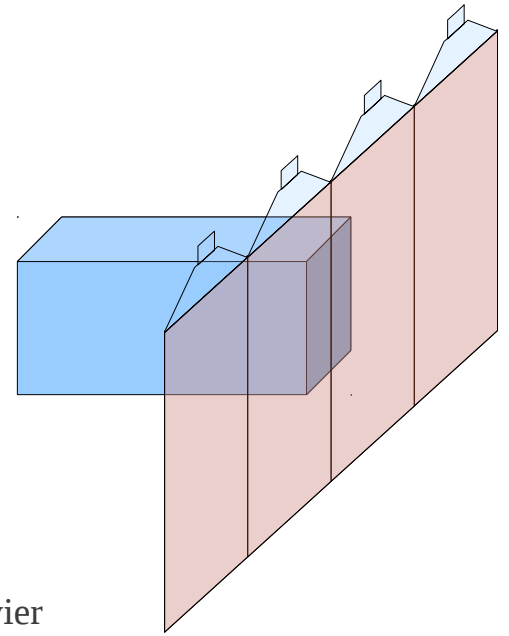
Concepts for Veto Paddle Arrangements

- Active area must be small to minimize detection of particles not related to events in TPC
- Active area must include most particles scattered at large angles from TPC
  - TPC dimensions are taken to be 40 cm x 47 cm x 90 cm
- Must provide accurate information about when particles leave the TPC
- Paddles should be configured like Venetian blinds to avoid dead areas between scintillator paddles

Original Concept : 4 Parallel Fishtail Paddles

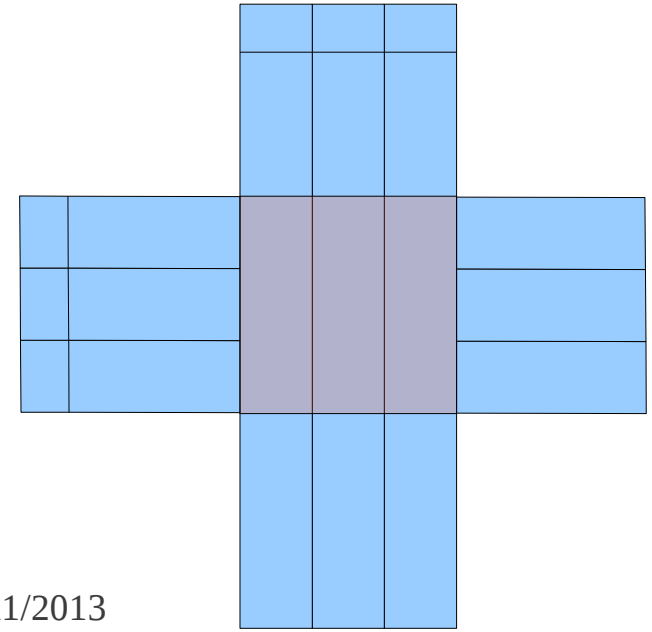
- Active Area: 124.0 cm x 90.5 cm
- In one layer, so no coincidence readings can be taken.

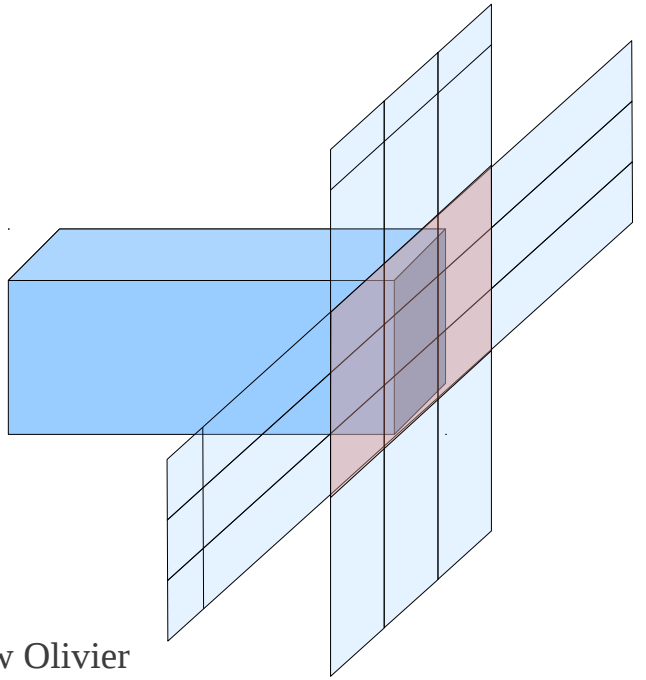




Concept 2: 6 CDF Long Paddles

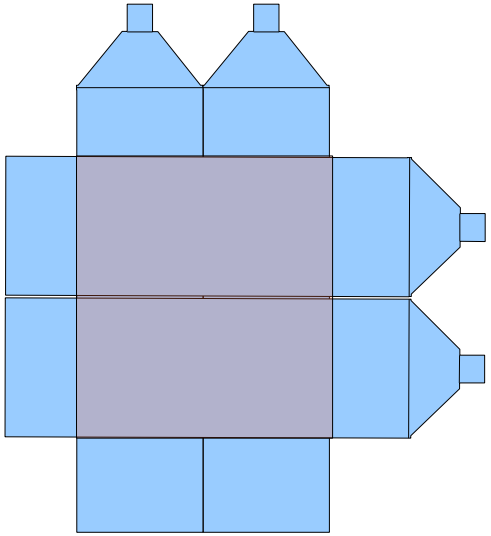
- Active Area: 50.0 cm x 50.0 cm
- Must be in two layers to best match area of TPC face and to get coincidence between measurements for accurate information

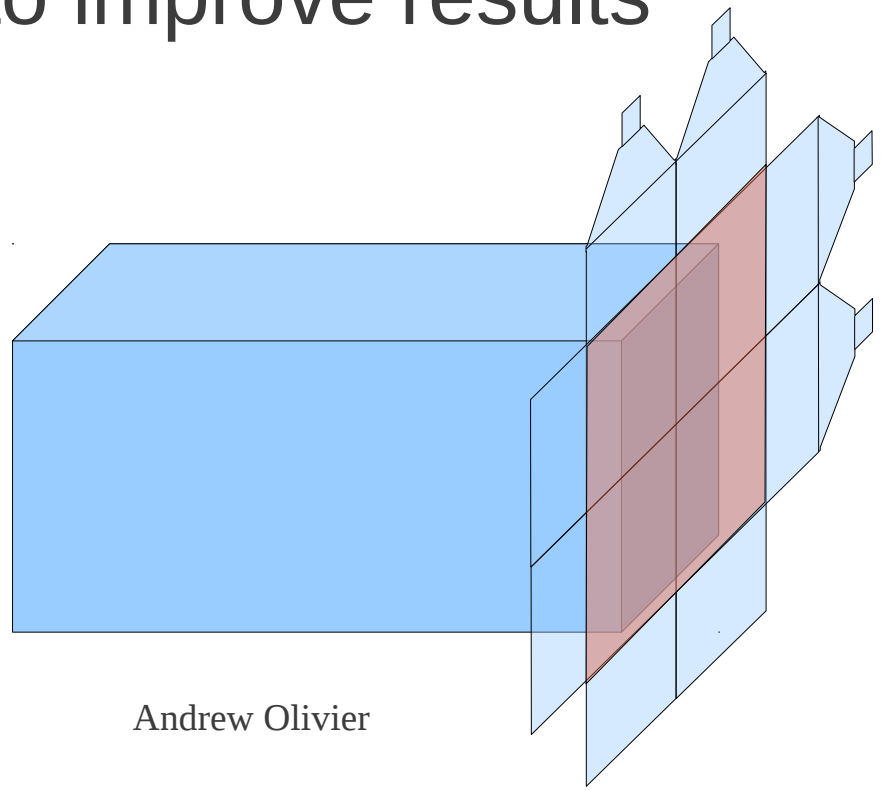




Concept 3: 4 Fishtail Paddles

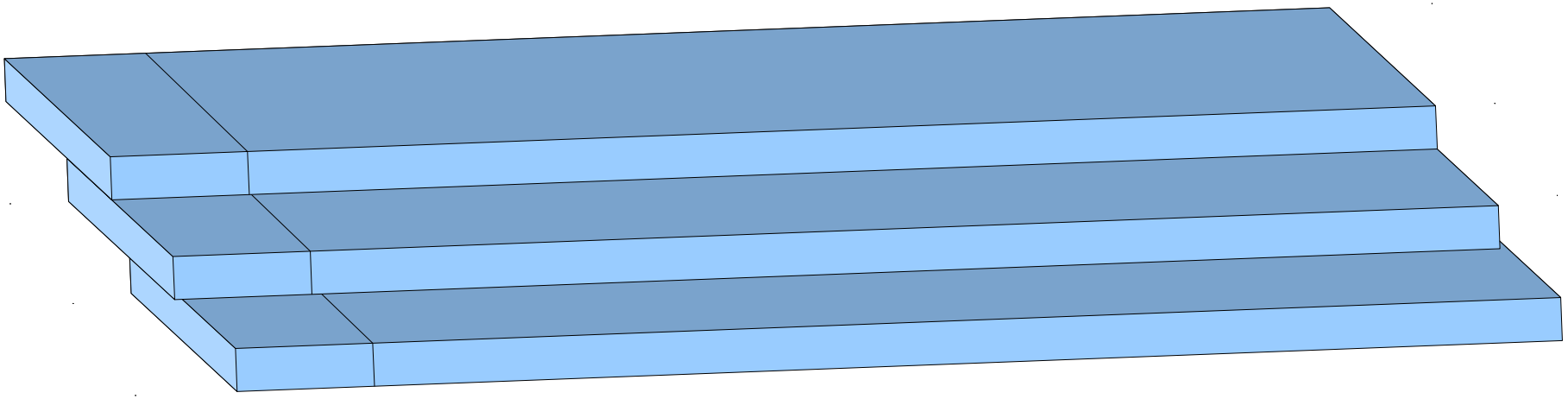
- Active Area: 62.0 cm x 62.0 cm
- In two layers primarily to provide best match to area of TPC, but also allow for coincidence measurements to improve results





Venetian Blind Configuration

- Since the paddles' sides are not perfectly smooth, they should be staggered to avoid inactive areas between scintillators.



Future Work and Conclusions

- Fishtail paddles must be tested to compare efficiencies and noise percentages with CDF paddles
- Must decide on size of active area of veto
- Possibly modify dimensions of scintillators used to better fit needed active area
- Assemble and test veto once design has been determined